Graphene sensors for ultrasensitive environmental monitoring

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We demonstrate proof-of-concept graphene sensors for environmental monitoring of ultralow concentration NO_2 in complex environments. Robust detection in a wide and environmentally relevant range of NO_2 concentrations, 10−154 ppb, was achieved, highlighting the great potential for graphene-based NO_2 sensors, with applications in environmental pollution monitoring, portable devices, automotive and mobile sensors for a global real-time monitoring network. The measurements were performed in a complex environment, combining NO_2/synthetic air/water vapour, traces of other contaminants, and variable temperature in an attempt to fully replicate the environmental conditions of a working sensor. It is shown that the performance of the graphene-based sensor can be affected by co-adsorption of NO_2 and water at low temperatures (≤70 °C). However, the sensitivity to NO_2 increases significantly when the sensor operates at 150 °C and the cross-selectivity to water, SO_2, and CO is minimized. Additionally, it is demonstrated that single-layer graphene exhibits two times higher carrier concentration response upon exposure to NO_2 than bilayer graphene.

References

[1] Ch. Melios, et al., ACS Sensors. 3, 1666 (2018).

Figures

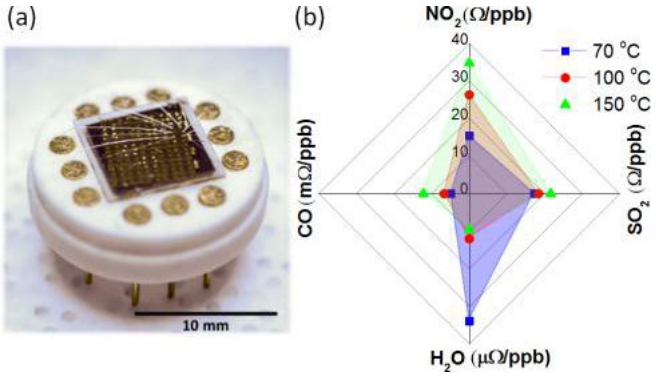

Figure 1: (a) Graphene sensing element; (b) Sensitivity of the graphene-based sensor for humidity, NO_2, SO_2 and CO at different temperatures.